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WHAT'S NOW AND NEXT IN ANALYTICS, AI, AND AUTOMATION

BRIEFING NOTE • MAY 2017

Innovations in digitization, analytics, artificial intelligence, and automation are creating performance and productivity opportunities for business and the economy, even as they reshape employment and the future of work.

Over the past few years, rapid technological advances in digitization and data and analytics have been reshaping the business landscape, supercharging performance and enabling the emergence of new business innovations and new forms of competition and business disruption. Yet progress has been uneven. While many companies struggle to harness the power of these technologies, companies that are fully leveraging the capabilities are capturing disproportionate benefits, transforming their businesses and outpacing—and occasionally disrupting—the rest.

At the same time the technology itself continues to evolve rapidly, bringing new waves of advances in robotics, analytics, and artificial intelligence (AI), and especially machine learning. Together they amount to a step change in technical capabilities that could have profound implications for business, for the economy, and more broadly for society as a whole. Machines today increasingly match or outperform human performance in a range of work activities, including ones that require cognitive capabilities, learning, making tacit judgments, sensing emotion, and even driving—activities that used to be considered safe from automation. Adoption of these technologies could bring significant new performance and transformational benefits to companies that go beyond simply substituting labor and lead to previously unimagined breakthrough performance and outcomes. Moreover, they have the potential to boost the productivity of the global economy at a time when it is sorely needed for growth and the share of the working-age population is declining. Yet their advent raises difficult questions about how companies can best prepare for and harness these technologies, the skills and organizational reinvention that will be required to make the most of them, and how the leaders in the private and public sector as well as workers will adapt to the impact on jobs, capability-building and the nature of work itself.

1. THE OPPORTUNITY AVAILABLE NOW

Some companies are gaining a competitive edge with their use of data and analytics, which can enable faster and larger-scale evidence-based decision making, insight generation, and process optimization. But the opportunity-capture is uneven, and there is both room to catch up and to excel. Harnessing digitization's potential is similarly uneven.

Data and analytics are now widely acknowledged as transformational, yet many companies are capturing only a fraction of their value

Data and analytics have been changing the basis of competition in the years since our first report on big data in 2011. Leading companies are using their capabilities not only to improve their core operations but also to launch entirely new business models. The network effects of digital platforms are creating a winner-take-most dynamic in some markets. Yet while the volume of available data has grown exponentially in recent years, most companies are capturing only a fraction of the potential value in terms of revenue and profit gains.

We recently revisited the five large sectors we focused on in our 2011 big data research and found that only two of them—location-based services and retail—had made progress in capturing the benefits, in part because of competition from digital native companies. The three other sectors—manufacturing, the public sector, and healthcare—had captured less than 30 percent of the potential value highlighted previously.

Effective data and analytics transformations have several components. The first step should be asking fundamental questions to shape the strategic vision: What will data and analytics be used for? How will the insights drive value? Which data sets are the most useful for the insights needed? The second element is solving for the problems in the way data is generated, collected, and organized. Many incumbents struggle to switch from legacy data systems to a more nimble and flexible architecture that can get the most out of big data and analytics. They may also need to digitize their operations more fully in order to capture more data from their customer interactions, supply chains, equipment, and internal processes. The third piece is acquiring the skills needed to derive insights from data; organizations may choose to add in-house capabilities or outsource to specialists. The fourth component is a common stumbling block: changing business processes to incorporate data insights into the actual workflow. This requires getting the right data insights into the hands of decision-makers – and making sure that these executives and mid-level managers know how to use data-driven insights.

Putting all these components in place is not easy. Many companies seeking to extract value from data and analytics struggle to incorporate data-driven insights in their daily business. In a recent McKinsey survey of more than 500 executives representing companies across the spectrum of industries, regions, and sizes, more than 85 percent acknowledged that they were only somewhat effective at meeting goals they set for their data and analytics initiatives.

Data and analytics are already disrupting business models and bringing performance benefits—and this process is still early, with more to come

Disruptive data-driven models and capabilities are reshaping some industries, and could transform many more. Certain characteristics of a given market (such as inefficient matching of supply and demand underutilized assets, dependence on demographic data when behavioral data is now available, and human biases and errors) open the door to disruption by those using new data-driven approaches. Several archetypes of that disruption are highlighted in Exhibit 1. They point to opportunities that leaders should address—and that competitors will target.

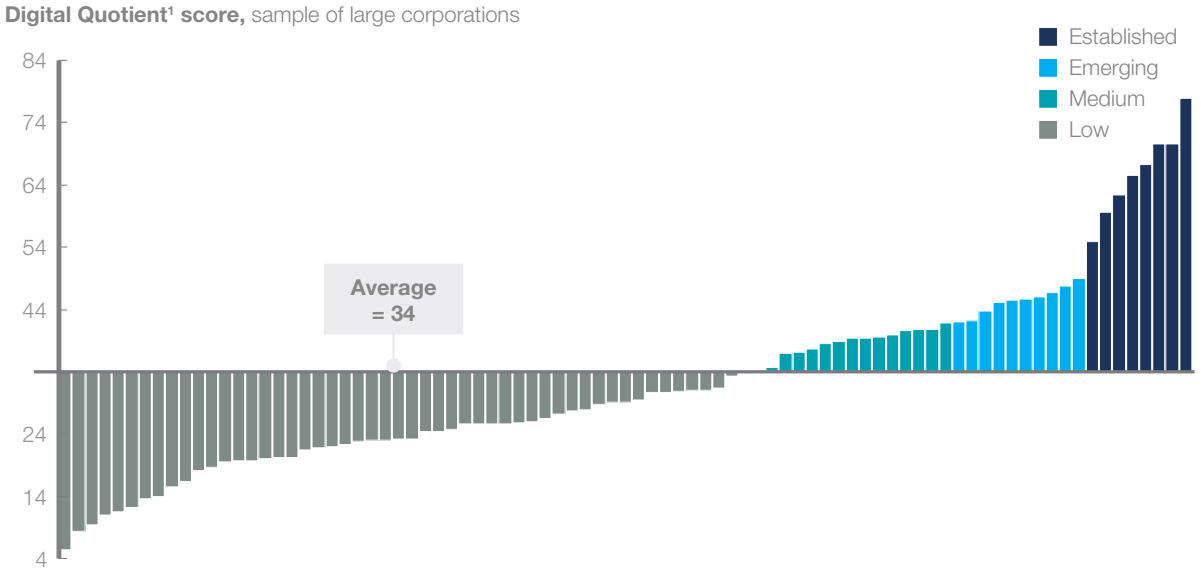
In industries where most incumbents have become used to relying on standardized data to make decisions, bringing in fresh types of data sets ("orthogonal data") to supplement those already in use can change the basis of competition. We

Exhibit 1: Data and analytics underpin six disruptive models, and certain characteristics make individual domains susceptible

Indicators of potential for disruption	Archetype of disruption	Domains that could be disrupted
▪ Assets are underutilized due to inefficient signaling ▪ Supply/demand mismatch ▪ Dependence on large amounts of personalized data ▪ Data is siloed or fragmented ▪ Large value in combining data from multiple sources ▪ R&D is core to business model ▪ Decision making is subject to human biases ▪ Speed of decision making limited by human constraints ▪ Large value associated with improving accuracy of prediction	**Business models enabled by orthogonal data**	▪ Insurance ▪ Healthcare ▪ Human capital/talent
	Hyperscale, real-time matching	▪ Transportation and logistics ▪ Automotive ▪ Smart cities and infrastructure
	Radical personalization	▪ Healthcare ▪ Retail ▪ Media ▪ Education
	Massive data-integration capabilities	▪ Banking ▪ Insurance ▪ Public sector ▪ Human capital/talent
	Data-driven discovery	▪ Life sciences and pharmaceuticals ▪ Material sciences ▪ Technology
	Enhanced decision making	▪ Smart cities ▪ Healthcare ▪ Insurance ▪ Human capital/talent

Source: McKinsey Global Institute analysis

Exhibit 2: The extent of digitization varies by company, with a large gap between digital leaders and the rest



1 By evaluating 18 practices related to digital strategy, capabilities, and culture, McKinsey has developed a single, simple metric for the digital maturity of a company.

Source: McKinsey Digital Quotient company survey, 2014–15; Tanguy Catlin, Jay Scanlan, and Paul Willmott, "Raising your Digital Quotient," *McKinsey Quarterly,* June 2015, McKinsey.com

see this playing out for example in property and casualty insurance, where new companies have entered the marketplace with telematics data that provides insight into driving behavior, beyond the demographic data that had previously been used for underwriting. One of the most powerful uses is micro-segmentation based on behavioral characteristics of individuals. This is changing the fundamentals of competition in many sectors, including education, travel and leisure, media, retail, and advertising.

Digitization, more broadly, is also progressing unevenly among companies, sectors, and economies –and leaders are reaping benefits

The corporate world's broader embrace of digitization is similarly uneven. Our use of the term digitization (and our measurement of it), encompasses (1) digitization of assets, including infrastructure, connected machines, data, and data platforms, etc., (2) digitization of operations, including processes, payments and business models, customer and supply chain interactions and (3) digitization of the workforce, including worker use of digital tools, digitally skilled workers, new digital jobs and roles. In measuring each of these various aspects of digitization, we find relatively large disparities even among big companies (Exhibit 2).

Our research finds that companies with advanced digital capabilities across assets, operations and workforces grow revenue and market shares faster than peers. They improve profit margins three times more rapidly than average and, more often than not, have been the fastest innovators and the disruptors in their sectors—and in some cases beyond them. These are the digital leaders operating on the digital frontier. It's not that the rest are not doing anything digital—which company doesn't have a digital initiative these days? Rather, the point is that, compared with the leaders, the rest are significantly behind in their use of digital capabilities for competitive advantage. Many of these top performers were "born digital," but perhaps more impressive are the smaller set of incumbent companies that have actively transformed themselves into digital leaders and benefit doubly from their traditional strengths and their new digital capabilities.

There are also disparities between sectors in terms of degree of digitization. In the United States, the information and communications technology (ICT) sector, media, financial services, and professional services are surging ahead, while utilities, mining, and manufacturing, among others, are in the early stages of digitizing. In labor-intensive industries such as retail and healthcare, substantial parts of their large workforces do not use technology extensively (Exhibit 3). These differences matter because the least digitized sectors tend to be the larger sectors in the economy and often the relatively low productivity

Exhibit 3: The extent of digitization varies by sector

1 Information and communications technology.

Source: Appbrain; BEA; BLS; Bluewolf; Computer Economics; eMarketer; Gartner; IDC; industry-expert interviews; Live Chat customer satisfaction report; McKinsey Payments Map; McKinsey social technology survey; US Census; *US contact center decision-makers' guide*; McKinsey Global Institute analysis

sectors with relatively lower wage growth. These sectors thereby represent an opportunity to increase sector level as well as economy-wide productivity growth, at a time when it is sorely needed for economic growth.

This unevenness can also be observed across countries; all have significant room to increase their digitization. The US economy as a whole is reaching only 18 percent of its digital potential, but still ahead of European countries. France has achieved 12 percent of its digital potential, the European Union average, while Germany and Italy are at 10 percent. Emerging economies are even further behind, with countries in the Middle East and Brazil capturing less than 10 percent of their digital potential.

Digitization is transforming globalization, creating opportunities for companies and economies

The world is more connected than ever, but the nature of its connections has changed in a fundamental way. The volume of cross-border data flows has grown 45 times larger since just 2005. It

is projected to increase by an additional nine times over the next five years, as flows of information, searches, communication, video, transactions, and intra-company traffic continue to surge. As well as transmitting valuable streams of information and ideas in their own right, data flows enable the movement of goods, services, finance, and people. Virtually every type of cross-border transaction now has a digital component. Approximately 12 percent of the global goods trade is conducted via international e-commerce, with much of it driven by platforms such as Alibaba, Amazon, eBay, Flipkart, and Rakuten. Beyond e-commerce, digital platforms for both traditional employment and freelance assignments are beginning to create a more global labor market. Some 50 percent of the world's traded services are already digitized. These transformations enable small and medium-sized enterprises around the world to compete head to head with larger industry incumbents.

2. THE NEXT WAVE OPPORTUNITY THAT IS FAST EMERGING

Coming over the horizon is a new wave of opportunity related to the use of robotics, machine learning, and AI. Companies that deploy automation technologies can realize substantial performance gains and take the lead in their industries, even as their efforts contribute to economy-level increases in productivity.

Advances in robotics, AI, and machine learning herald a new era of breakthrough innovation and opportunity

Recent advances in robotics, machine learning, and AI are pushing the frontier of what machines are capable of doing in all facets of business and the economy. Physical robots have been around for a long time in manufacturing, but more capable, more flexible, safer, and less expensive robots are now engaging in ever expanding activities and combining mechanization with cognitive and learning capabilities—and improving over time as they are trained by their human coworkers on the shop floor, or increasingly learn by themselves.

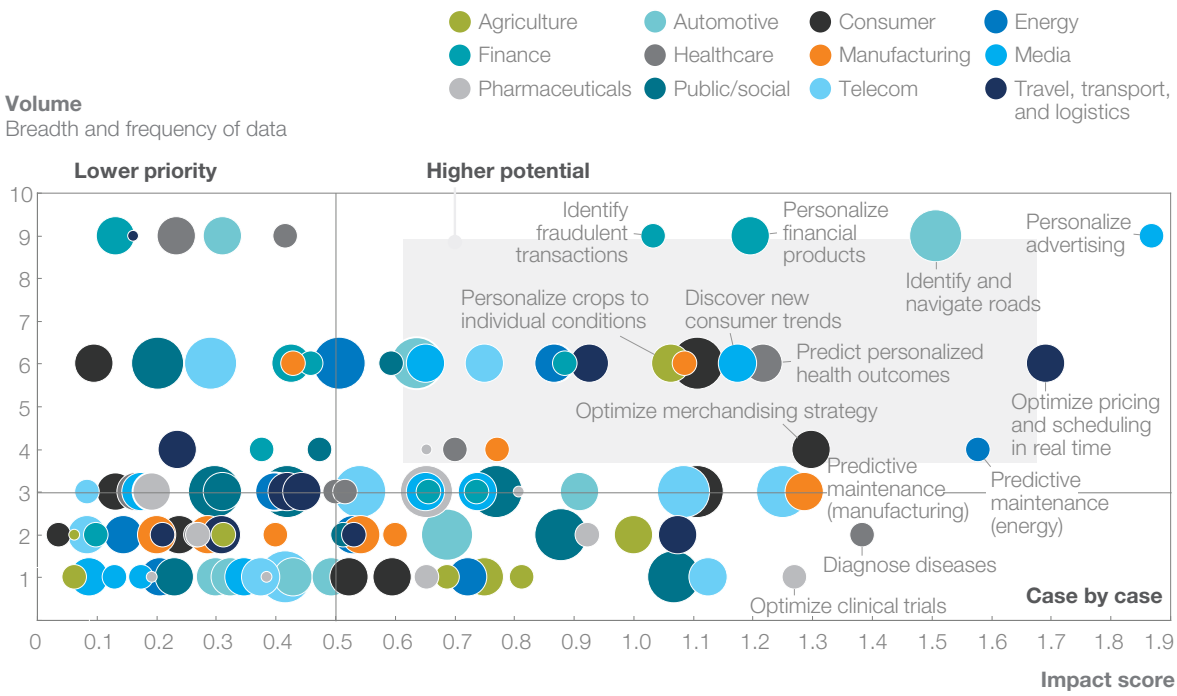
The idea of AI is not new, but the pace of recent breakthroughs is. Three factors are driving this acceleration: First, machine-learning algorithms have progressed in recent years, especially through the development of deep learning and reinforcement-learning techniques based on neural networks. Second, exponentially increasing computing capacity has become available to train larger and more complex models much faster. Graphics processing units (GPUs), originally designed to render the computer graphics in video games, have been repurposed to execute the data and algorithm crunching required for machine learning at speeds many times faster than traditional processor chips. More silicon-level advances beyond the current generation of GPUs are already emerging, such as tensor processing units. This compute capacity has been aggregated in hyper-scalable data centers and is being made much more accessible to users through the cloud. Third, massive amounts of data that can be used to train machine learning models are being generated, for example through daily creation of billions of images, online click streams, voice and video, mobile locations, and sensors embedded in the Internet of Things. The combination of these breakthroughs has led to spectacular demonstrations like DeepMind's AlphaGo, which defeated a human champion of the complex board game Go in March 2016. With each passing month, new milestones are being achieved in numerous areas, often with performance beyond human capabilities. In 2016, for example, Google's DeepMind and the University of Oxford applied deep learning to a huge data set of BBC programs to create a lip-reading system that is more accurate than a professional lip-reader.

To be clear, formidable technological challenges must still be overcome before machines can match human performance across the range of cognitive activities. One of the biggest technical challenges is for machines to acquire the capability to understand and generate natural language—capabilities that are indispensable for a multitude of work activities. Digital personal assistants such as Apple's Siri, Amazon's Alexa, and Google Assistant, are still in development—and often imperfect—even though their progress is palpable for millions of smartphone users.

Harnessing these evolving technologies will unlock multiple benefits for companies beyond labor substitution

For companies, successful adoption of these evolving technologies will significantly enhance performance and can be a critical competitive advantage and differentiator. Some of the gains will come from labor substitution, but automation also has the potential to enhance productivity, raise throughput, and improve predictions, outcomes, accuracy, and optimization, as well expand the discovery of new solutions in massively complex areas such as synthetic biology and material science. Adoption will also improve quality and safety, and provide opportunities to create new business models—and it could unlock the otherwise unlikely combination of scale and agility, creating the ability to propagate changes across an entire organization instantaneously.

Exhibit 4: Machine learning has broad potential across industries and use cases



Already today, a range of automation technologies is generating real value. Rio Tinto, for example, has deployed automated haul trucks and drilling machines at its mines in Pilbara, Australia, and says it is seeing 10–20 percent increases in utilization there. Google has applied artificial intelligence from its DeepMind machine learning to its own data centers, cutting the amount of energy they use by 40 percent. In financial services, automation in the form of "straight-through processing," where transaction workflows are digitized end-to-end, can increase the scalability of transaction throughput by 80 percent, while concurrently reducing errors by half.

Furthermore, a plethora of machine learning business use cases are emerging across sectors. These include a larger number that involve significant value at stake and potential for impact in sectors where much of the data needed for machine learning is rapidly becoming available (Exhibit 4).

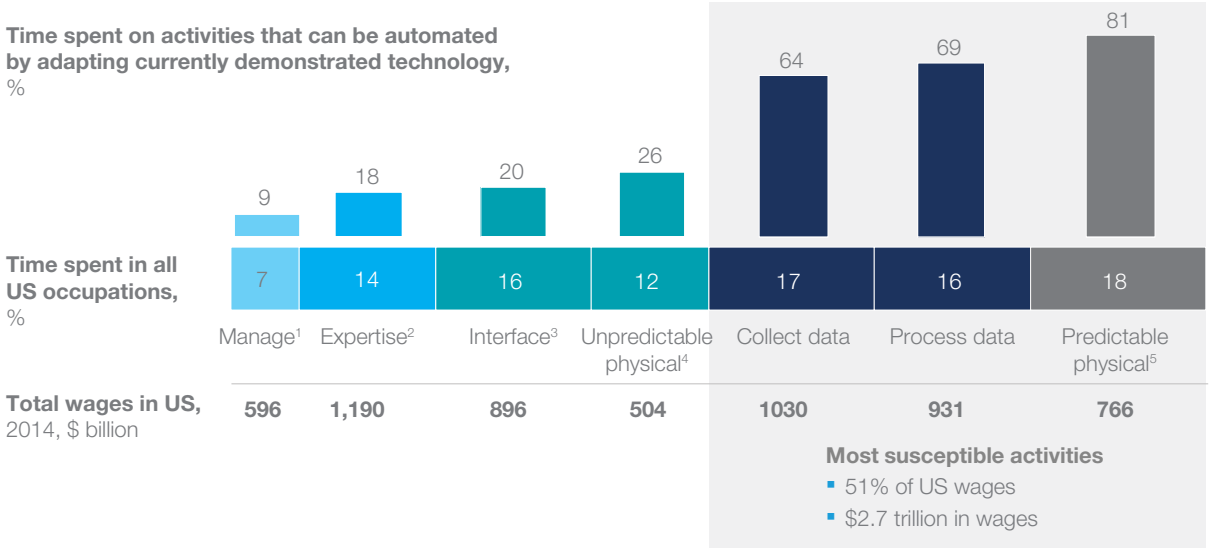
Scenarios we developed for several settings, including a hospital emergency department, aircraft maintenance, oil and gas operations, a grocery store, and mortgage brokering, show that the value of the potential benefits of automation—calculated as a percentage of operating costs—could range from between 10-15 percent for a hospital emergency department to 25 percent for aircraft maintenance, and to more than 90 percent for mortgage origination. While labor substitution accounts for some of this value, non-labor performance benefits are considerable in every case.

AI and Automation will provide a much-needed boost to global productivity and may help some "moonshot" challenges

The application of AI and the automation of activities can enable productivity growth and other benefits not just for businesses, but also for entire economies. Economic growth over the last 50 years has been driven equally by growth in productivity and growth in labor supply. No longer. Demographic effects, such as aging and falling birth rates, are now set to dramatically slow the growth in labor supply. To pick up the slack, productivity growth will need to increase sharply to sustain economic growth—this at a time when productivity growth has been less than stellar in most economies. At a macroeconomic level, based on our scenario modeling, we estimate automation alone could raise productivity growth on a global basis by 0.8 to 1.4 percent annually. In short, businesses and the economy need the productivity boost from automation.

AI and other technologies can also be broadly beneficial for society by helping tackle some "moonshot" challenges, including climate change or curing disease. AI is already being deployed in synthetic biology, cancer research, climate science, and material science. For example, researchers at McMaster and Vanderbilt Universities have used computers to exceed the human standard in

Exhibit 5: Some activities have higher technical automation potential



1 Managing and developing people.

2 Applying expertise to decision making, planning, and creative tasks.

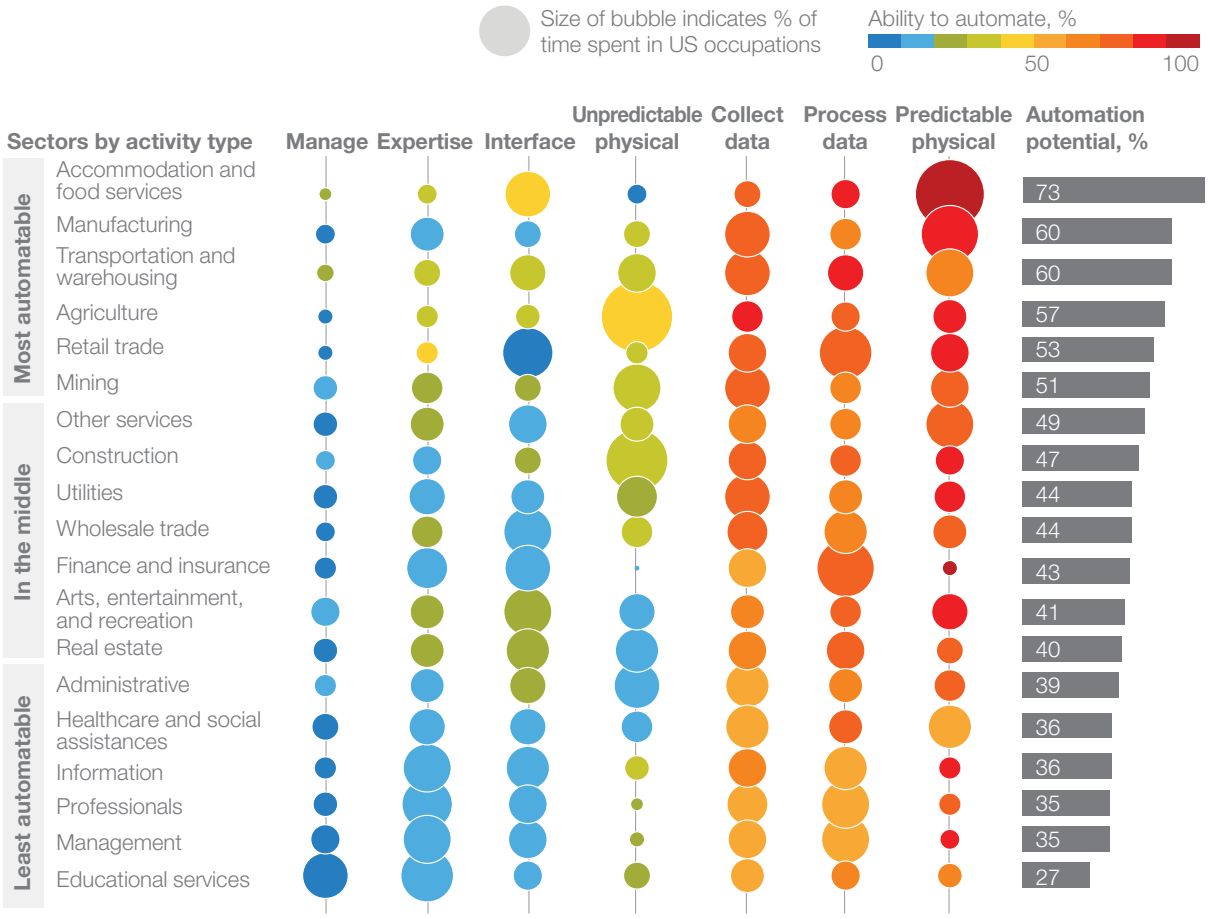
3 Interfacing with stakeholders.

4 Performing physical activities and operating machinery in unpredictable environments.

5 Performing physical activities and operating machinery in predictable environments.

Source: US Bureau of Labor Statistics; McKinsey Global Institute analysis

Exhibit 6: Some sectors have more automatable activities than others



Source: US Bureau of Labor Statistics; McKinsey Global Institute analysis

predicting the most effective treatment for major depressive disorders and eventual outcomes of breast cancer patients.

3. WHAT ABOUT EMPLOYMENT AND WORK?

The advent of a new automation age is raising public concerns about the effect on employment and the future of work. For most occupations, partial automation is more likely than full automation in the medium term, and the technologies will provide new opportunities for job creation.

About half the activities carried out by workers today have the potential to be automated

The employment implications of automation are challenging for business, governments and workers alike. To assess the implications, we focused on work activities rather than whole occupations as a starting point. We consider work activities to be a useful measure since occupations are aggregations of different activities, where each discrete activity has a different potential for automation. For example, a retail salesperson will spend some time interacting with customers, stocking shelves, or ringing up sales. Each activity is distinct and requires different capabilities to perform successfully. In addition we bounded our assessment by considering currently demonstrated (rather than theoretical) capabilities in AI and automation technologies.

Activities that are more easily automatable include physical activities in highly predictable and structured environments, as well as data collection and data processing (Exhibit 5). These activities account for 51 percent of wages in the US economy and exist across the entire spectrum of sectors, though they are more prevalent in sectors such as accommodation and food service, manufacturing, transportation and warehousing, and retail trade (Exhibit 6).

Our analysis of the automation potential extends to 46 countries representing about 80 percent of the global workforce. Overall, we estimate that about half of the activities that people are paid almost $15 trillion to do in the global economy have the potential to be automated by adapting currently demonstrated technology. Four economies—China, India, Japan, and the United States—account for just over half of the total wages and almost two-thirds the number of employees associated with activities that are technically automatable. There are sizable differences in automation potential between countries, based mainly on the structure of their economies, the relative level of wages, and the size and dynamics of the workforce (Exhibit 7).

Looking across skill and wage categories, it is clear that all occupations will be affected. Only a small proportion of all occupations, about 5 percent, consist of 100 percent of activities that are fully automatable using currently demonstrated technologies. However, we find that about 30 percent of the activities in 60 percent of all occupations could be automated (Exhibit 8). This means that many workers will work alongside rapidly evolving machines, which will require worker skills also to evolve. This rapid evolution in the nature of work will affect everyone from welders to landscape gardeners, mortgage brokers—and CEOs; we estimate about 25 percent of CEOs' time is currently spent on activities that machines could do, such as analyzing reports and data to inform decisions.

Several key factors will influence the pace and extent of automation. These include (1) technical feasibility of automation, a critical first step that will depend on sustained breakthrough innovation, but alone is not sufficient; (2) cost of developing and deploying solutions; (3) labor market dynamics, including supply and demand, and costs of human labor as an alternative to automation; (4) business and economic benefits, not merely labor substitution benefits but also benefits from new capabilities that go beyond human capabilities; (5) regulatory, user and social acceptance, which can affect the rate of adoption even when deployment makes business and economic sense. A useful analogy to consider is that electric vehicles were demonstrated to be technically feasible several decades ago, but it was not until factors like (2)-(5) above became realistic that they showed up on the road.

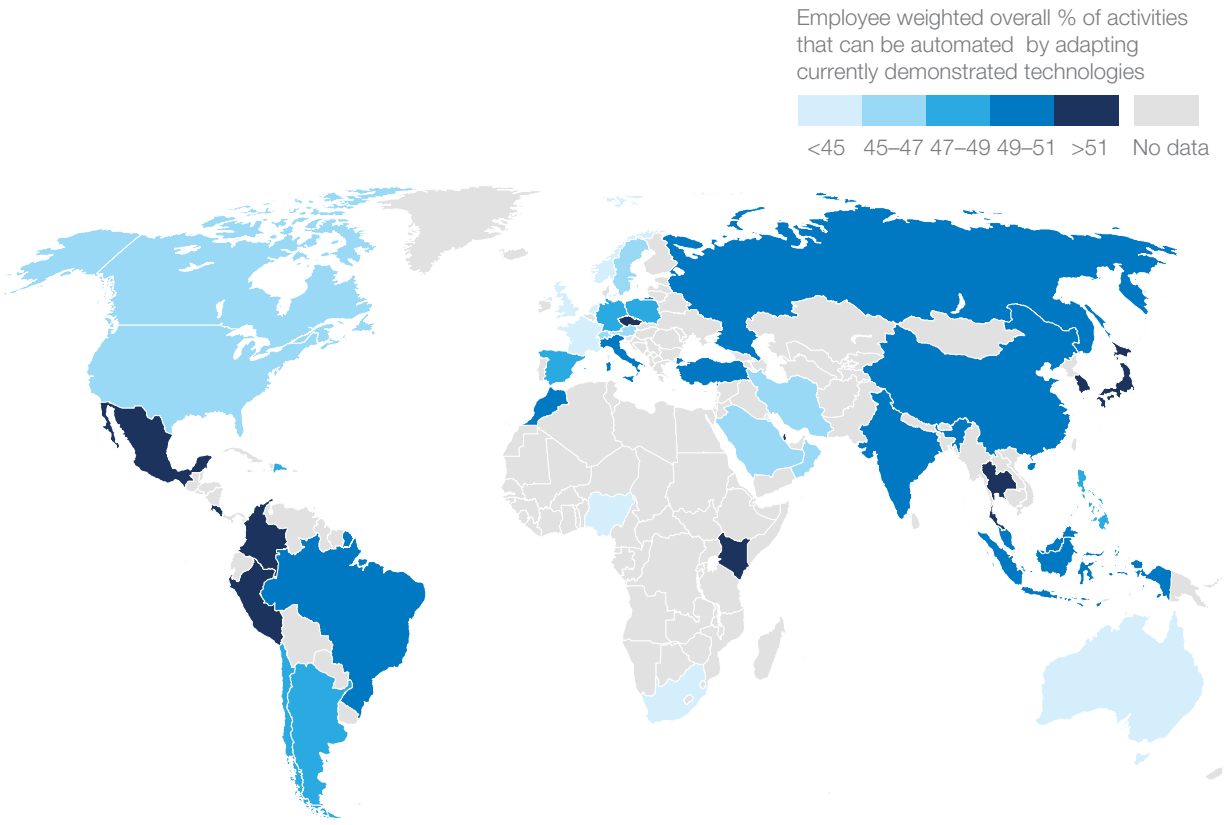
While the macro-advance of automation might appear slow across entire sectors or economies, the effects may be quite fast at a micro level for particular occupations and sectors, especially where the costs and benefits are compelling, and social acceptance and utility is high. This is already the case in some micro-cases, for example the use of personal AI-enabled agents on smart devices such as Apple's Siri and Amazon's Alexa.

Technology will also help create new jobs and new opportunities for generating income, and will help labor markets function better

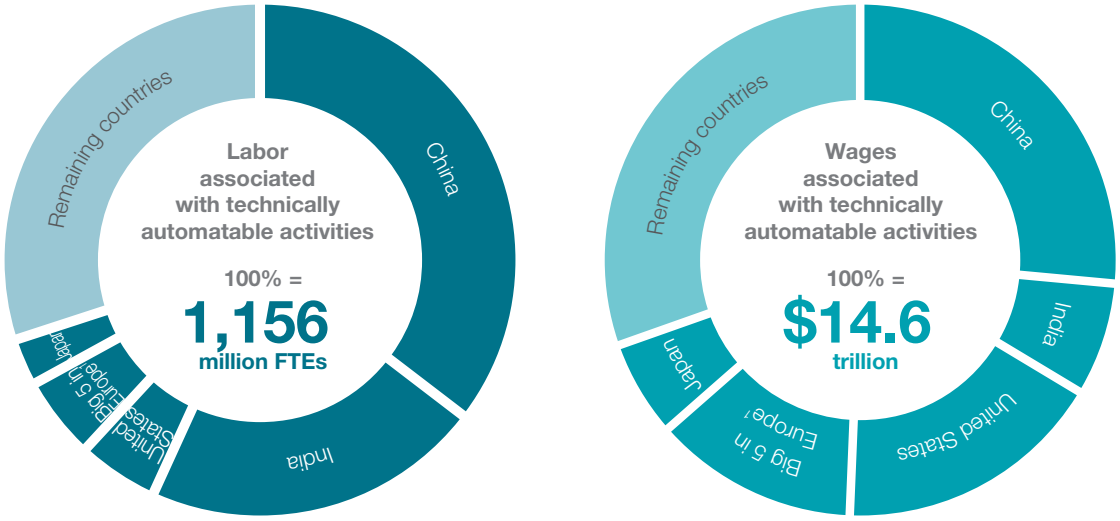
Have we seen this movie before? Certainly. The scale of shifts in the labor force, over the many decades of automation that are now likely beginning, is of a similar order of magnitude to the long-term technology-enabled shifts in developed countries as most workers moved from farms to factories and service jobs. Those shifts did not result in long-term mass unemployment because they were accompanied by the creation of new types of work not foreseen at the time. We cannot definitively say whether historical precedent will be repeated this

Exhibit 7: All countries could be affected by automation

Automatability across economies
Employee weighted overall % of activities that can be automated



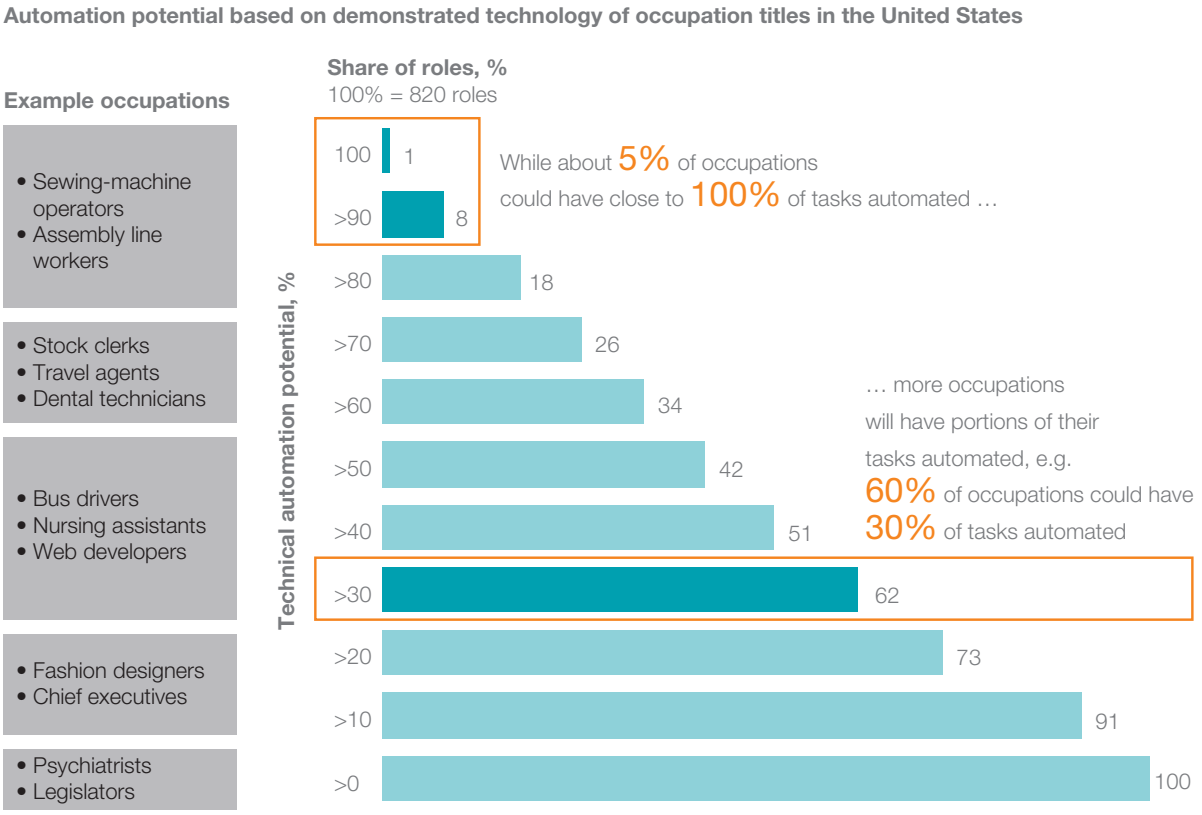
Technical automation potential is concentrated in countries with the largest populations and/or high wages
Potential impact due to automation, adapting currently demonstrated technology (46 countries)



1 France, Germany, Italy, Spain, and United Kingdom.

Source: EMSI database; Oxford Economics forecasts; US Bureau of Labor Statistics; McKinsey Global Institute analysis

Exhibit 8: While few occupations are fully automatable, 60 percent of all occupations have at least 30 percent of activities that are technically automatable



time. But our analysis shows that humans will still be needed in the workforce. So even while technologies replace some jobs, they are creating new work in industries that most of us cannot even imagine, as well as new ways to generate income and match talent to jobs. One third of new jobs created in the United States in the past 25 years were types that did not previously exist, or barely existed, in areas including IT development, hardware manufacturing, app creation, and IT systems management. The growing role of big data in the economy and business will create a significant need for statisticians and data analysts, for example; we estimate a shortfall of up to 250,000 data scientists in the United States in a decade.

Technology helps work in other ways. Digital talent platforms such as LinkedIn have already begun to improve the matching of workers with jobs, creating transparency and efficiency in labor markets, and thereby raising GDP. While it is early days, there is already evidence that such platforms can raise labor participation and working hours. With their powerful search capabilities and sophisticated screening algorithms, online talent platforms can also speed the hiring process and cut the time individuals spend searching between jobs, reducing unemployment. By aggregating data on candidates and job openings across entire countries or regions, they may address some geographic mismatches and enable matches that otherwise would not have come about. Finally, online talent platforms help put the right people in the right jobs, thereby increasing their productivity along with their job satisfaction. They can draw people who are engaged in informal work into formal employment, especially in emerging economies. Both of these effects could increase output per worker, raising GDP.

While independent work is nothing new (and self-employment is still the predominant form of work in emerging economies), the digital enablement of it is. The modern 9-to-5 job, which dates back to the Industrial Revolution, is being challenged by technology-enabled independent work. Our research finds that 20 to 30 percent of the working age population in the United States and the European Union is engaged in independent work. Just over half of these workers supplement their income and have traditional jobs, or are students, retirees, or caregivers. While 70 percent choose this type of work, 30 percent turn to it out of necessity because

they cannot find a traditional job at all, or one that meets their income and flexibility needs. The proportion of independent work that is conducted on digital platforms, while only about 15 percent of independent work overall, is growing rapidly, driven by the scale, efficiency, and ease of use for workers and customers that these platforms enable. Such platforms include Uber, Etsy, Didi, and others. Those who pursue independent work (digitally enabled or not) out of preference are generally satisfied, although those who pursue it out of necessity are unsatisfied with the income variability and the lack of benefits typically associated with traditional work. Policy makers and innovators will need to grapple with solutions to these challenges.

4. WHAT SHOULD LEADERS DO?

Business leaders and policy makers have an imperative: to find ways to harness the potential of these technologies, even as they will have to address the significant challenges.

Business leaders

For businesses, the opportunities are clear. Leaders should embrace the transformation and performance opportunities already available to them (and their competitors) from data, analytics, and digitization, as well as the rapidly evolving opportunities in AI, robotics, and automation. To harness these benefits, business leaders will not only have to invest in technology, but also in transforming their organizations. Specific approaches will vary business by business, however several new mindsets will be critical:

- **Testing, experimenting, learning, and scaling fast:** Beyond book knowledge, business leaders will need to amass practical knowledge from devoting resources to experiments applying technologies to real problems, and then scaling those that show promise.

- **Reimagining business models and business processes:** To make full use of the power of analytics, AI, and other digital technologies will require a thorough reimagining of processes, with priorities for which processes to transform. Similarly, leaders will need to reimagine how current business models could be transformed and how new business models could be created based on these capabilities.

- **Digital assets and capabilities as the "new balance sheet":** These assets and capabilities, both hard and soft, are increasingly becoming a competitive differentiator and platforms for innovation and disruption. Each business regardless of industry and sector will likely need to assess how distinctive its digital assets and capabilities are vs. those of competitors. Some competitors will bring nothing more than world-class versions of these capabilities, along with different business models, and compete effectively.

- **Staying calibrated and investing accordingly:** When it comes to digital capabilities and progress on digitization initiatives, all too often business leaders are satisfied with progress vs. their own past. The most relevant calibration will be relative to (1) the scale of the opportunity and (2) vs. competitors and potential disruptors both from within their sectors and from outside them, which is where digitally enabled disruptions often come from.

- **A new focus on human capital, including integrating workers and machines:** Companies are likely to face gaps in skills they need in a more technology-enabled workplace, and would benefit from playing a more active role in education and training. Partial automation is more likely than full automation in the near to mid-term, and humans and machines will need to work together much more closely. That will require retraining and often redeploying workers.

Policy makers (and business leaders concerned with wider economic and societal implications)

Policy makers also have a powerful incentive to embrace the productivity growth opportunity for their economies that these technologies offer. This will help ensure future prosperity, and create the surpluses that can be used to assist workers and society adapt to these rapid changes. At the same time, policy makers must evolve and innovate policies that help workers and institutions adapt to the impact on employment:

- **Adopting policies to encourage investment:** Through tax benefits and other incentives, policy makers can encourage companies to invest in human capital. Policy makers could accelerate the creation of jobs in general through stimulating investment, and accelerate creation of digital jobs in particular.

- **Encouraging new forms of entrepreneurship and more rapid new business formation:** Digitally enabled opportunities for individuals to earn incomes must be found. In addition, accelerating the rate of new business formation will be critical. This will likely require simplifying regulations, creating tax and other incentives.

- **Public-private partnerships to stimulate infrastructure investment:** The lack of enabling digital infrastructure is holding back the digital benefits for some emerging economies—and even underserved regions in developed countries. Public-private partnerships could help address market failures.
- **Rethinking education, training, and learning:** Policy makers working with education providers could do more to improve basic science, technology, engineering, and math (STEM) skills through the school systems, and put a new emphasis on creativity as well as critical and systems thinking.
- **Rethinking income support and safety nets:** If automation (full or partial) does result in a significant reduction in employment and/or greater pressure on wages, some ideas such as universal basic income, conditional transfers, and adapted social safety nets may need to be considered and tested.
- **Incent investment in human capital:** A broad range of incentives exists for businesses to invest in R&D or otherwise develop their capital. Something similar is needed to encourage investment in human capital.

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